

The Gravity Loading Countermeasure Skinsuit

Completed Technology Project (2012 - 2016)



Project Introduction

Astronauts lose considerable bone mass during long duration spaceflight. These losses are one of the major concerns for proposed exploration class missions to the Moon, Mars, and Near Earth Objects due to the increase in fracture risk associated with reduced bone strength. These losses are seen even with the intervention of current exercise countermeasures. Although it is possible that the newest exercise machine, the Advanced Resistive Exercise Device (ARED), will be more effective in preventing bone and muscle losses, its size may be prohibitive in bringing it on interplanetary missions. In order for astronauts to be able to perform successful exploration tasks, they need to arrive at their destinations healthy and capable of doing work. Because of this, new countermeasures will need to be developed to prevent musculoskeletal deconditioning. The goal of this proposal is to meet this need by producing a wearable countermeasure suit. The suits primary goal will be to impose static loading, similar to that produced by gravity, on the user. In addition, incorporating a dynamic loading component, such as a form of vibration, may enhance the effectiveness of the suit. Finally, integrating the suit with existing countermeasures could serve to improve the overall efficacy of the entire countermeasure program. While astronauts currently exercise for around 2 hours, this suit could be worn for a longer period of time, including while the astronauts are performing other tasks. The suits will also be lightweight and easily packable, which is a major consideration for space exploration missions. The research objectives of this proposal are as follows: To produce a comprehensive model of suit-body interactions to aid in suit design To investigate the integration of the suit with existing countermeasures To investigate forms of dynamic loading, and their effects on subject comfort and performance To build and characterize prototype countermeasure suits The model from aim 1 will be created using Matlab and body modeling software, and will be used to inform suit design. It will be used to compute the effects of integrating the suit with existing countermeasures on overall suit characteristics. Dynamic loading mechanisms will be evaluated on their loading qualities and influence on subject comfort and performance. After the suits are constructed, their loading and comfort traits will be characterized. The Gravity Loading Countermeasure Skinsuit will reduce the musculoskeletal deconditioning seen during long duration spaceflight, allowing for a more robust and effective exploration program. The technologies developed in this proposal will also have applications in the medical field, for treating bed rest patients and in healing musculoskeletal injuries.

Anticipated Benefits

The Gravity Loading Countermeasure Skinsuit will reduce the musculoskeletal deconditioning seen during long duration spaceflight, allowing for a more robust and effective exploration program. The technologies developed in this proposal will also have applications in the medical field, for treating bed rest patients and in healing musculoskeletal injuries.



Project Image The Gravity Loading Countermeasure Skinsuit

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Responsible Program:

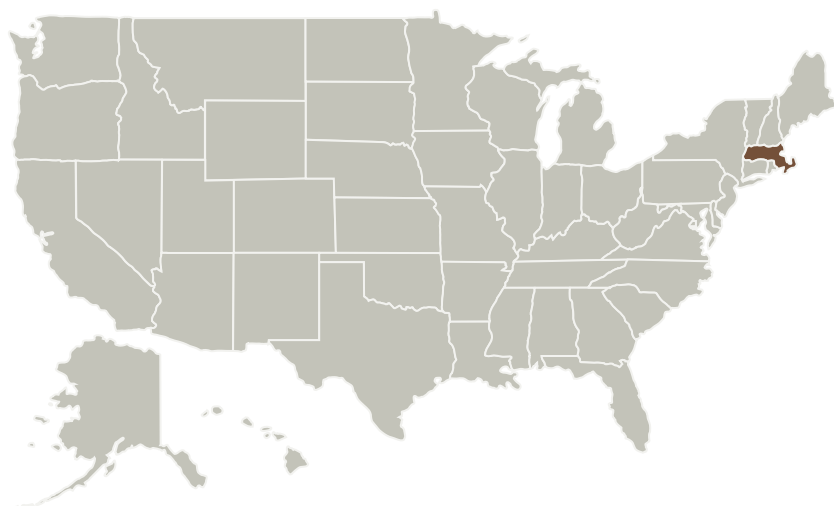
Space Technology Research Grants

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Primary U.S. Work Locations and Key Partners



Primary U.S. Work Locations

Massachusetts

Images



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Project Image The Gravity Loading Countermeasure Skinsuit

(<https://techport.nasa.gov/image/1834>)

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

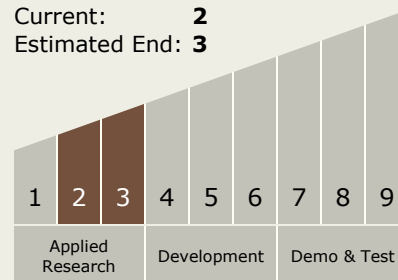
Dava J Newman

Co-Investigator:

Dustin P Kendrick

Technology Maturity (TRL)

Start: 2
Current: 2
Estimated End: 3



Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
 - └ TX06.3 Human Health and Performance
 - └ TX06.3.2 Prevention and Countermeasures

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Project Website:

<https://www.nasa.gov/directorates/spacetech/home/index.html>